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II. Solution by P. S BERR, Apple Creek, Ohio.

50 cents, cost of chicken + \$9.25, change given to purchaser of chicken = \$9.75, amount paid by poulturer. 50% of \$50 = \$25, amount received by poulturer. \$25 - \$9.75 = \$15.25 gain. $\$15.25 \div \$50 \times 100 = 3050$. Therefore the poulturer gained 3050%.

In the second condition the purchaser makes \$20, and the cost is 75 cents, therefore the gain per cent. is $10 \div .75 = 1333\frac{1}{3}$.

An excellent solution with a different result from either of the above was received from FRANK HORNE, a former student of Kidder Institute, Columbia, Missouri.

PROBLEMS.

38. Proposed by J. A. CALDERHEAD, B. Sc., Superintendent of Schools, Limaville, Ohio.

What must be the thickness of a 36-inch shell, in order that it may weigh 1 ton; supposing a 13-inch shell to weigh 200 pounds, when two inches thick?

39. Proposed by P. C. CULLEN, Superintendent of Schools, Brady, Nebraska.

A, B and C start from same point at same time. A north at rate of three miles per hour, B east at rate of four miles and C west at rate of five miles per hour. B at end of two hours starts at such an angle as to intersect A . How long after starting must C start north-west in order to meet A and B at common point?

ALGEBRA.

Conducted by J. M. CULAW, Monterey, Va. All contributions to this department should be sent to him.

SOLUTIONS TO PROBLEMS.

27. Proposed by A. H. BELL, Hillsboro, Illinois. (The problem from H. C. WILKES, Murrayville, West Virginia.)

An oarsman in rowing a boat down stream 7 miles from A to B and then back requires 12 minutes longer time, than commencing from B , and rowing up and back; the rate of speed for the 1st half of the time is 5 miles per hour, and for the 2nd half of the time is $4\frac{1}{2}$ miles per hour. Required the current.

1. Solution by H. C. WILKES, Murrayville, West Virginia.

Let $5 + x =$ rate down stream; and $5 - x =$ rate up.

$7 + 7\left(\frac{5+x}{5-x}\right) = \frac{70}{5-x}$ = length of continuous trip down = in time to trip down and up.

$7 + 7\left(\frac{4\frac{1}{2}-x}{4\frac{1}{2}+x}\right) = \frac{63}{4\frac{1}{2}+x}$ = length of continuous trip up = in time to trip up and down.

The change of rate in both trips will occur while going up stream and will be in the ratio $5-x:4\frac{1}{2}-x$.

$$\therefore \left(\frac{70}{5-x}\right)\left(\frac{5-x}{9\frac{1}{2}-2x}\right) = \text{distance 1st half of down trip.}$$

$$\left(\frac{63}{4\frac{1}{2}+x}\right)\left(\frac{5-x}{9\frac{1}{2}-2x}\right) = \text{distance 1st half of up trip.}$$

As the difference of time for whole trips is 12 minutes, the difference for $\frac{1}{2}$ time will be 6 minutes, or $\frac{1}{10}$ hour.

Then $\frac{70}{(5+x)(9\frac{1}{2}-2x)} - \frac{63}{(4\frac{1}{2}+x)(9\frac{1}{2}-2x)} = \frac{1}{10}$, which resolves into the equation $x^3 + 38x^2 + 99x - 855 = 0$, whence $x=3$.

II. Solution by A. H. BELL, Hillsboro, Illinois.

Let x =current, rowing down $5+x=a$, $4\frac{1}{2}+x=c$, half time = $\frac{y}{2}=z$.

1st trip rowing up $5-x=b$, $4\frac{1}{2}-x=d$, half time = $\frac{y+\frac{1}{2}}{2}=s$.

Then $\frac{7}{a}$ = time A to B , $s - \frac{7}{a} = \frac{as-7}{a}$ = time left of the 1st half from B to C , and giving the distance $\frac{abs-7b}{a}$; $7 - \frac{abs-7b}{a} = \frac{7(a+b)-abs}{a}$ = distance, C to A , and the time $\frac{7(a+b)-abs}{ad} = s = \frac{y+\frac{1}{2}}{2}$, giving $y = \frac{70(a+b)-a(b+d)}{5a(b+d)}$.

2nd trip--the 1st half of time from B to D gives the distance bz , distance D to A = $7-bz$, and time = $\frac{7-bz}{d}$, giving the time from A to B = $z - \frac{7-bz}{d} = \frac{z(b+d)-7}{d}$.

The distance equals $\frac{cz(b+d)-7c}{d} = 7$ miles, $z = \frac{7(c+d)}{c(b+d)} = \frac{y}{2}$, $y = \frac{14(c+d)}{c(b+d)}$. Equating the values of y , $c[70(a+b)-a(b+d)] = 70a(c+d)$.

Substituting values, $8x^3 + 38x^2 + 99x - 855 = 0$, giving $x=3$, with the other values imaginary.

III. Solution by B. F. BURLERSON, Oneida Castle, New York, and D. G. DURRANCE, Jr., Camden, New York.

Let x =rate of current; y =distance from B (returning) where the rate of rowing is changed; $2T$ =time of rowing from A to B and return; $2t$ = time of rowing from B to A and return; z =dist. from A (going up) where the rate of rowing is changed.

Put $a=7$ miles, $b=5$ miles, and $c=4\frac{1}{2}$ miles. Also put $2d=\frac{1}{2}$ hour, difference in time in making the journeys.

$$\text{Then, } \frac{a}{b+x} + \frac{y}{b-x} = T \dots (1); \frac{a-y}{c-x} = T \dots (2); \frac{a-z}{b-x} = t \dots (3);$$

$$\frac{z}{c-x} + \frac{y}{c+x} = t \dots (4); \text{ and } T = d + t \dots (5).$$

$$\text{From (2), } y = Tx - Tc + a \dots (6). \text{ From (3), } z = tx - tb + a \dots (7).$$

$$\text{Substituting value of } y \text{ in (1), } \frac{a}{b+x} + \frac{Tx - Tc + a}{b-x} = T \dots (8).$$

$$\text{From (5) and (6), } \frac{a}{b+x} + \frac{dx + tx - cd - ct + a}{b-x} = d + t \dots (9).$$

$$\text{Whence, } t = \frac{b^2d - 2dxc^2 - 2ab - bdx + bcd + cdx}{2x^2 - b^2 + bx - bc - cx}.$$

$$\text{The value of } z \text{ in (4), gives, } \frac{tx - tb + a}{c-x} + \frac{a}{c+x} = t \dots (10),$$

$$\text{whence } t = \frac{2ac}{c^2 - 2x^2 - cx + bx + bc}. \text{ Equating these two values of } t, \text{ after re-}$$

$$\text{storing numerical values, we have } \frac{252}{171 - 8^2 + 2x} = \frac{4x^2 + x + 1305}{950 - 10x - 40x^2}, \text{ from}$$

$$\text{which } 32x^4 - 326x^3 - 5301x^2 - 16245x = 0 \dots (11).$$

$$\text{Factoring (11), } (x^2 - 7\frac{1}{2}x + 14\frac{1}{2})(32x^2 + 248x + 1140) = 0.$$

From first factor, $x=3$ or $4\frac{1}{2}$, and from 2nd $x=-8.25062$ or -7.24938 . But of these values only $x=3$ is applicable. By substituting, $2T=5$ hours, $2t=4.8$, $y=3\frac{1}{2}$ miles, and $z=2\frac{1}{2}$ miles.

Also solved by F. P. MATZ and G. B. M. ZERR.

28. Proposed by H. W. DRAUGHON, Clinton, Louisiana.

The working capacity of a horse is constant between the ages of a and b years, and decreases at a uniformly accelerated rate from the age of b years to that of c years, becoming 0 at the latter age. If the value of the horse at the age of a years is d , give a formula for finding his value at any subsequent time.

Solution by the PROPOSER.

Let m represent the value of a year's work between the ages of a and b years; then, the value of the total amount of work done between those ages is, $(b-a)m \dots (1).$

Let y be the value of the work which the horse could do in one year at the age of $c-1$ years, and let x be any variable time reckoned from the age of c years backward. Then from formulas for uniform acceleration, we have,